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Tseng

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(54) **MAGNETIC BUCKLE**

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CPC ***A44B 11/258*** (2013.01); *A44D 2203/00* (2013.01); *Y10T 24/32* (2015.01)

(58) **Field of Classification Search**
CPC ... A45C 13/1069; A41F 1/002; A44B 11/258; Y10T 24/32; A44D 2203/00
See application file for complete search history.

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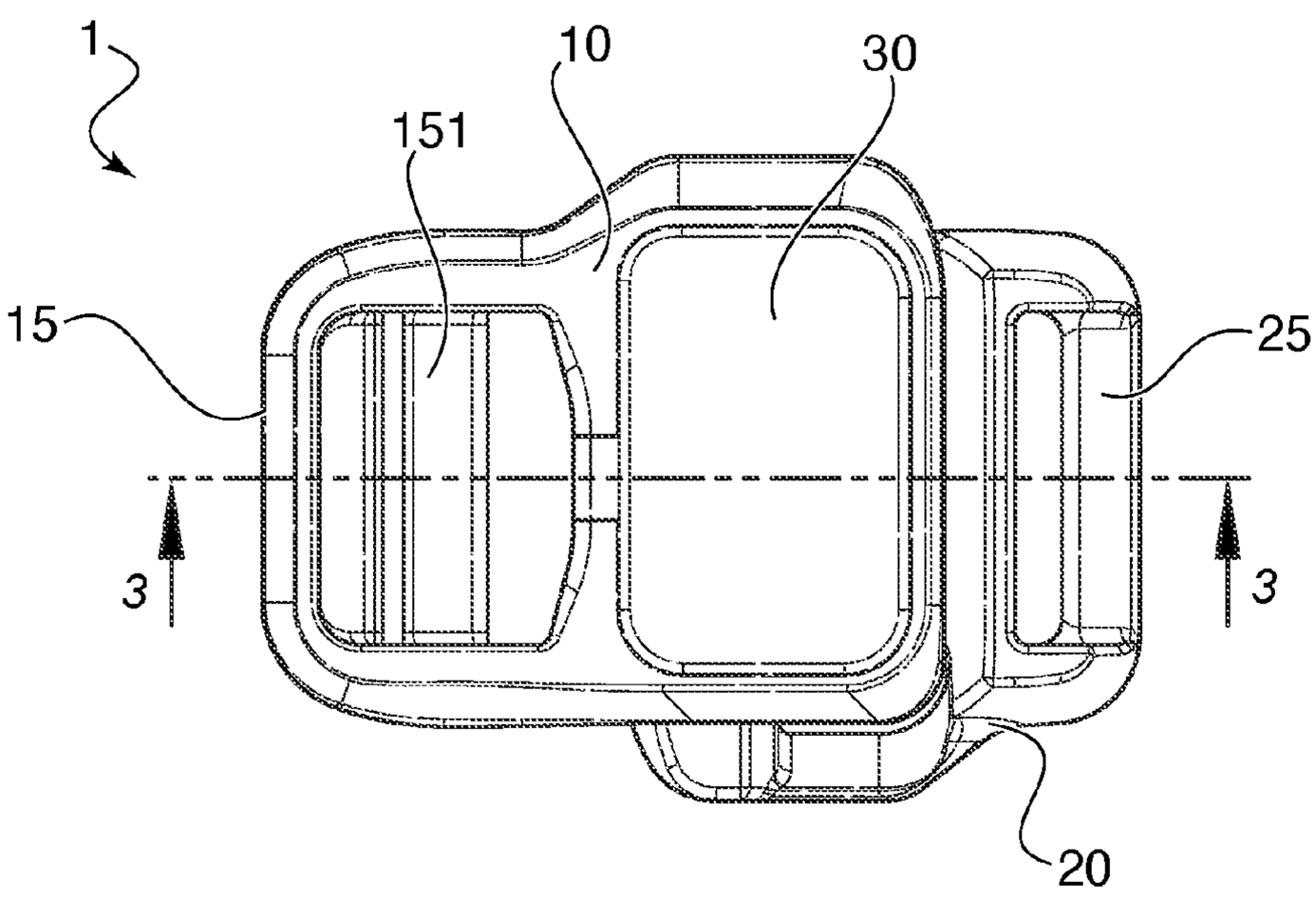
(57) **ABSTRACT**

A buckle assembly has a first buckle portion that cooperates with a second buckle portion. Each of the buckle portions has a main buckle body with two lateral sides and a magnet disposed in a magnet housing. A fastening hook is disposed on one lateral side, with a fastening opening and guide surface disposed on the opposite lateral side. Placing the interior surfaces of the buckle portions against each other causes the magnets to engage each other with magnetic attraction, and the fastening hooks of each buckle portion to enter the fastening openings of the other buckle portion, to lock the two buckle portions together. The buckle portions are disengaged by sliding the buckle portions in opposite lateral directions, perpendicular to the longitudinal extent of the buckle assembly, so that the fastening hooks slide along the opposing guide surface and force the magnets apart.

7 Claims, 6 Drawing Sheets



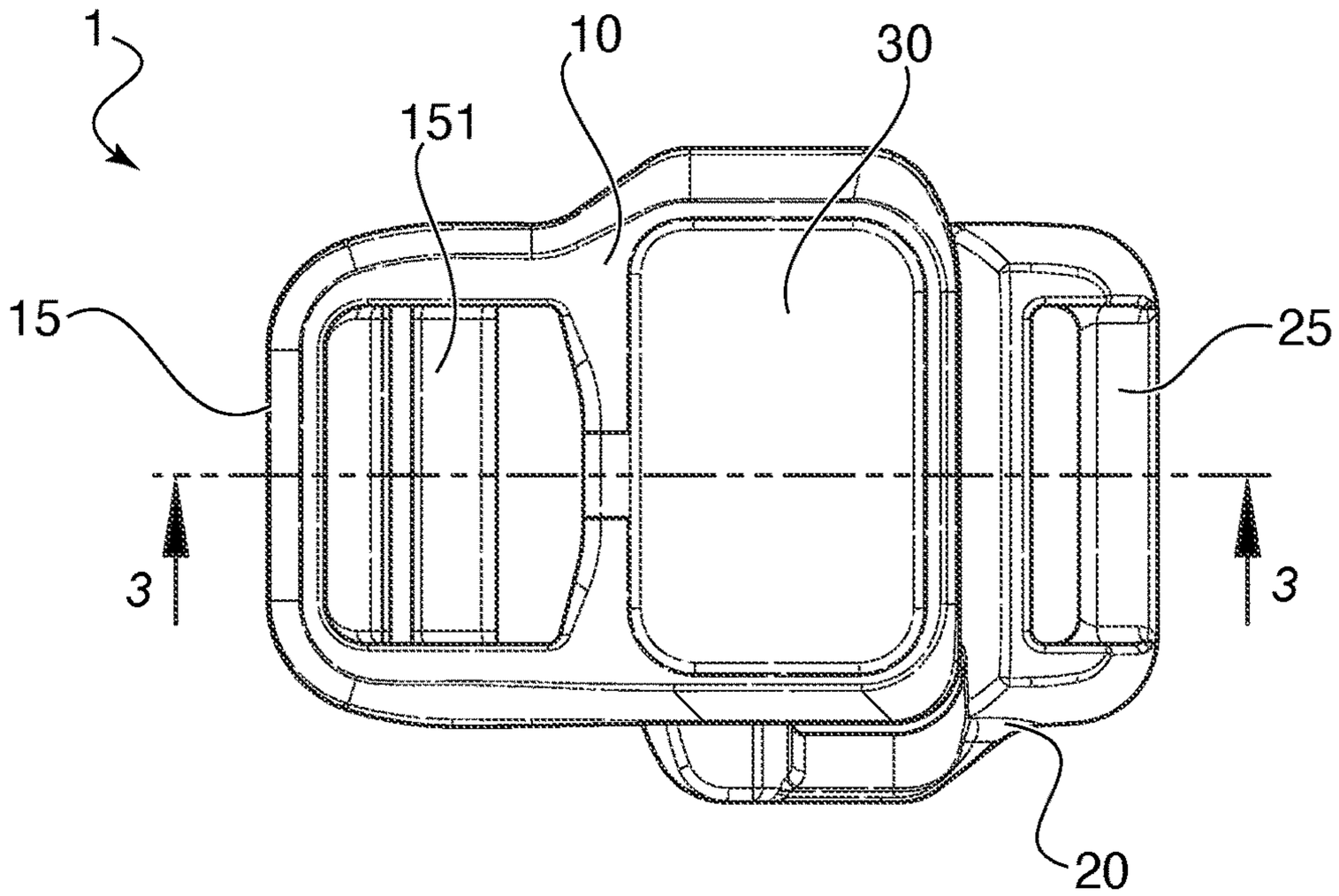


FIG. 1

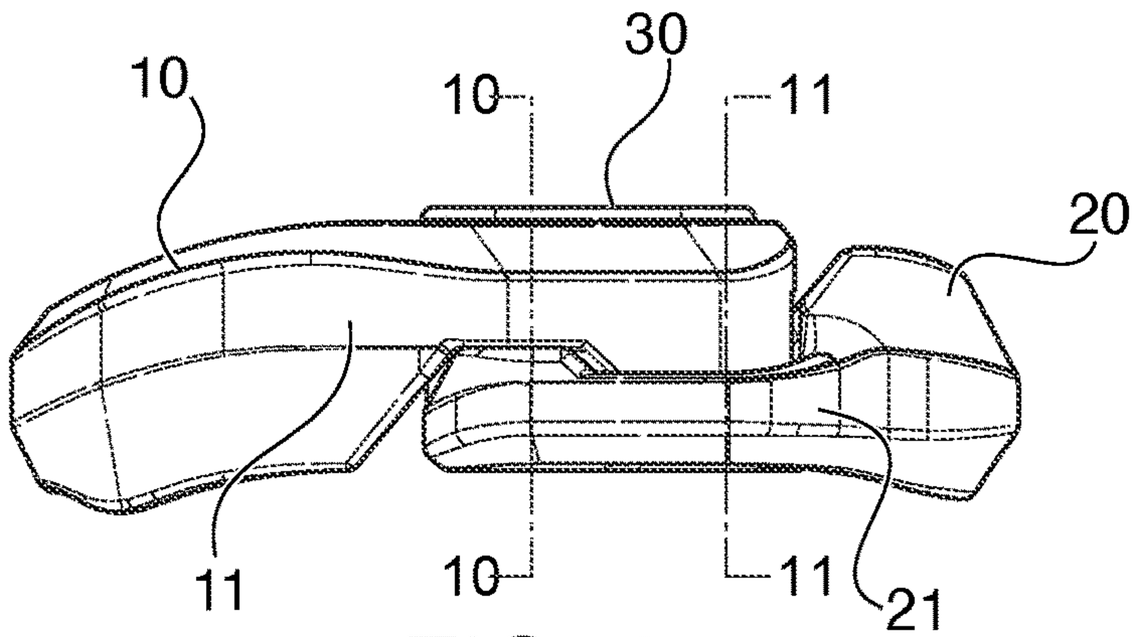


FIG. 2

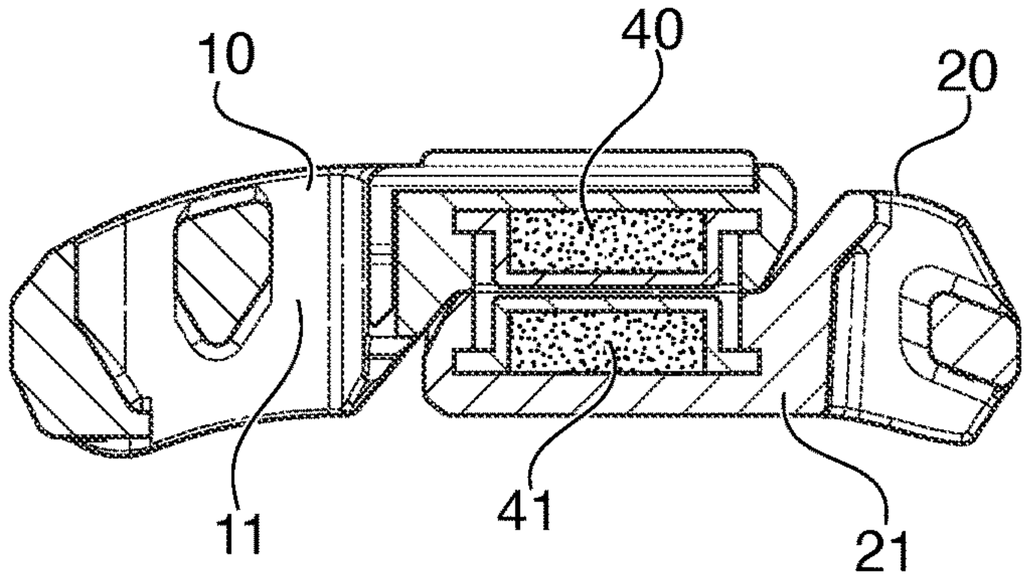


FIG. 3

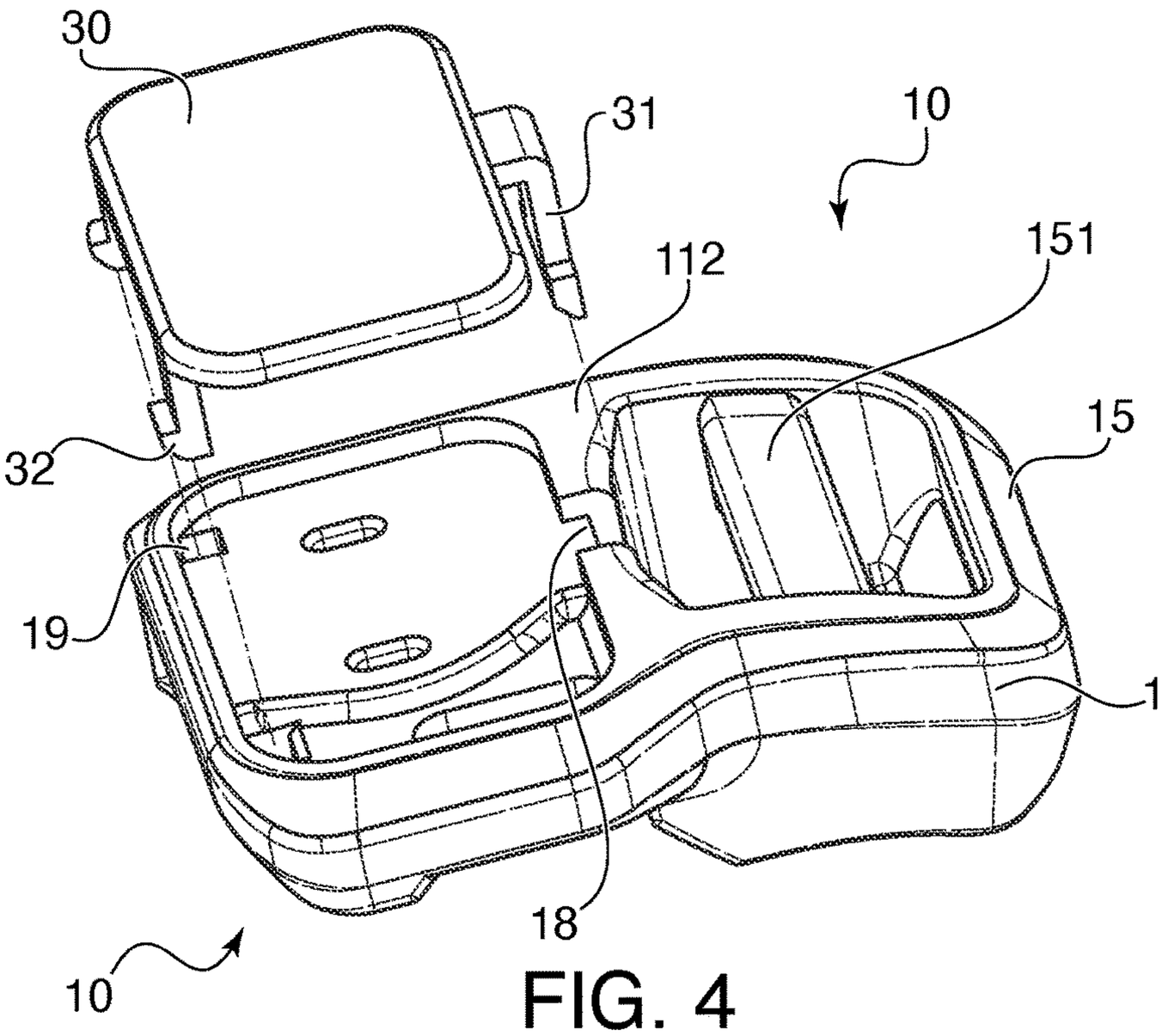


FIG. 4

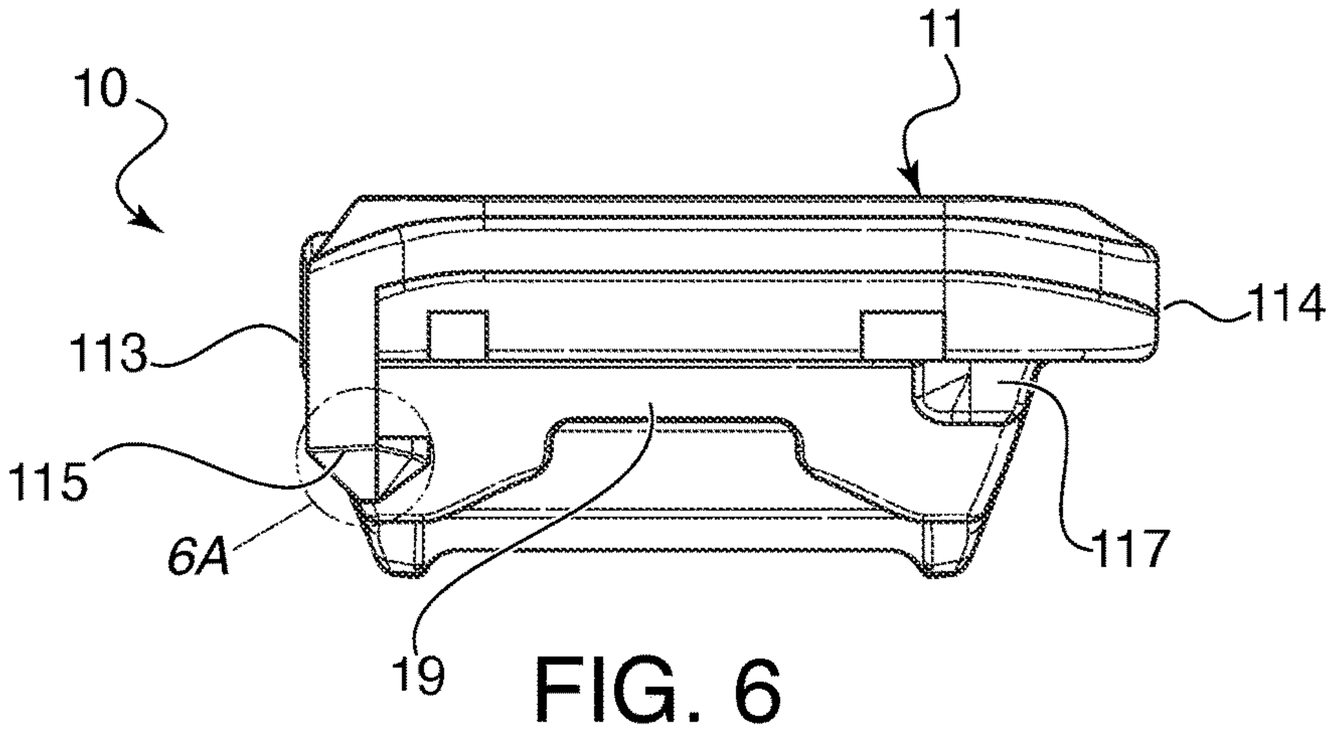


FIG. 6

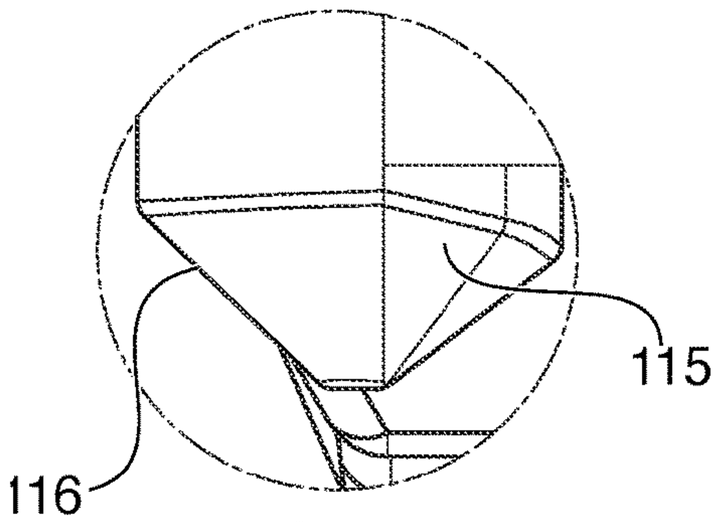


FIG. 6A

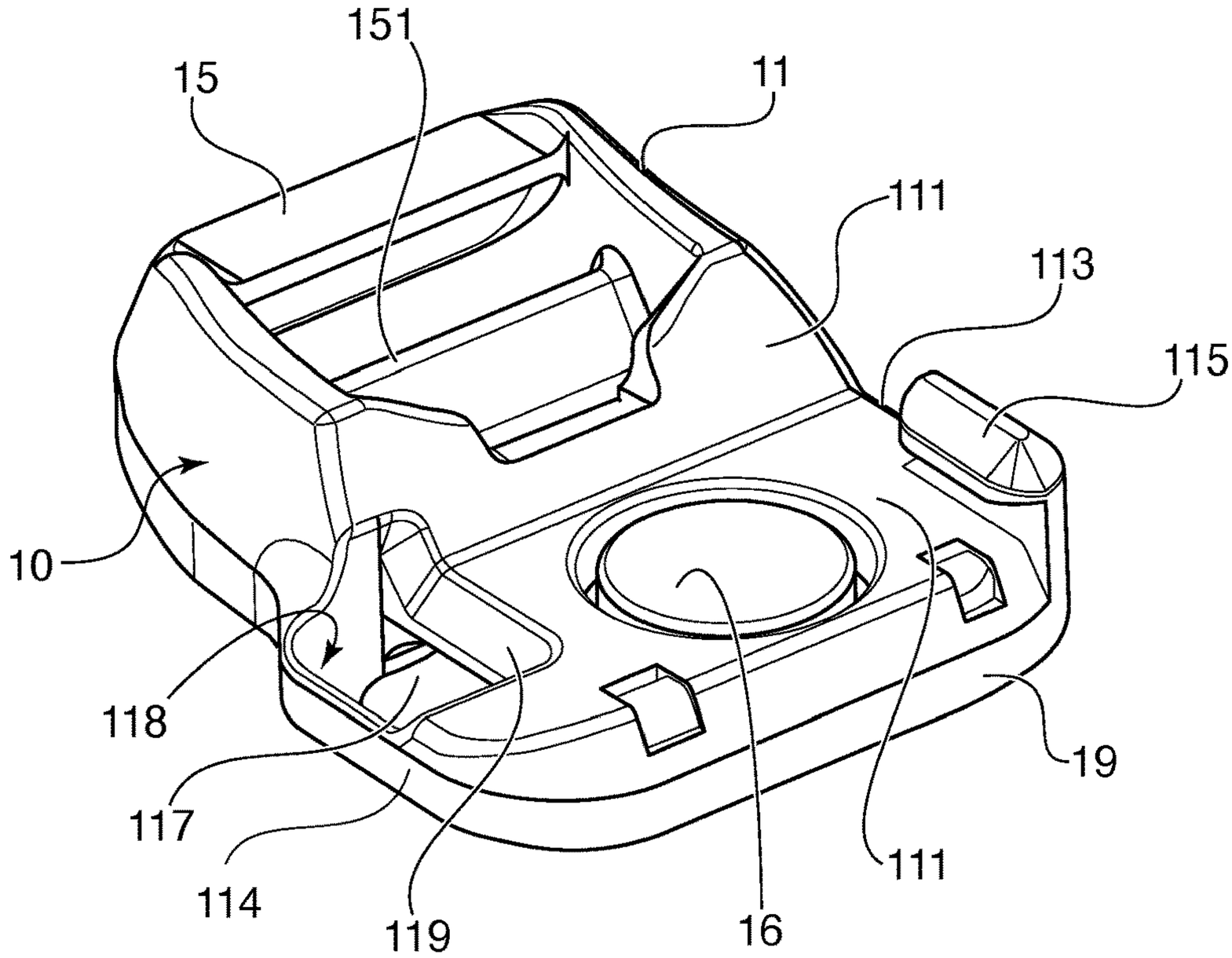

151
15
11
111
113
115
10
118
117
114
119
16
111
19

FIG. 5

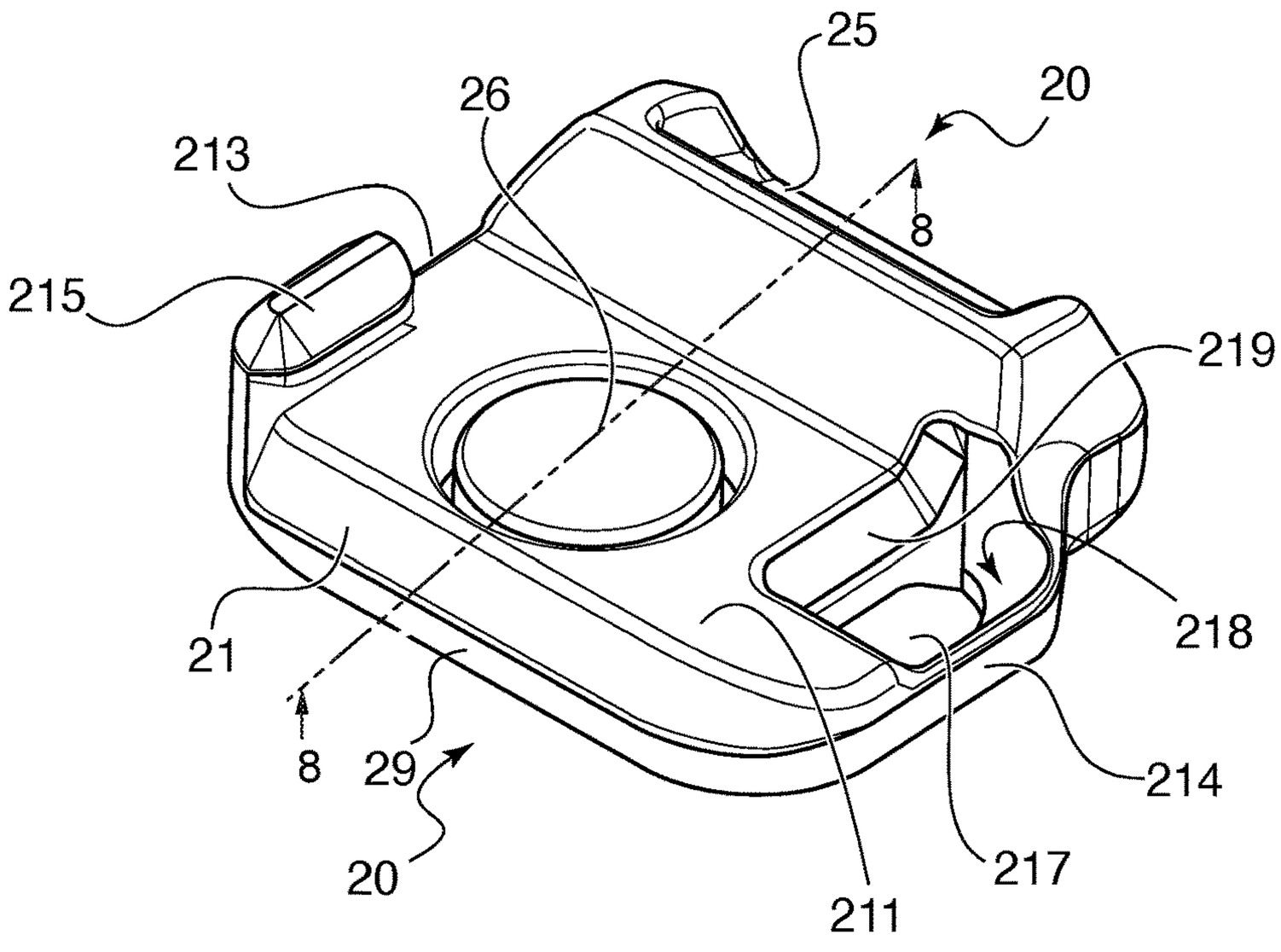

25
26
20
213
8
215
219
21
218
8
29
214
20
217
211

FIG. 7

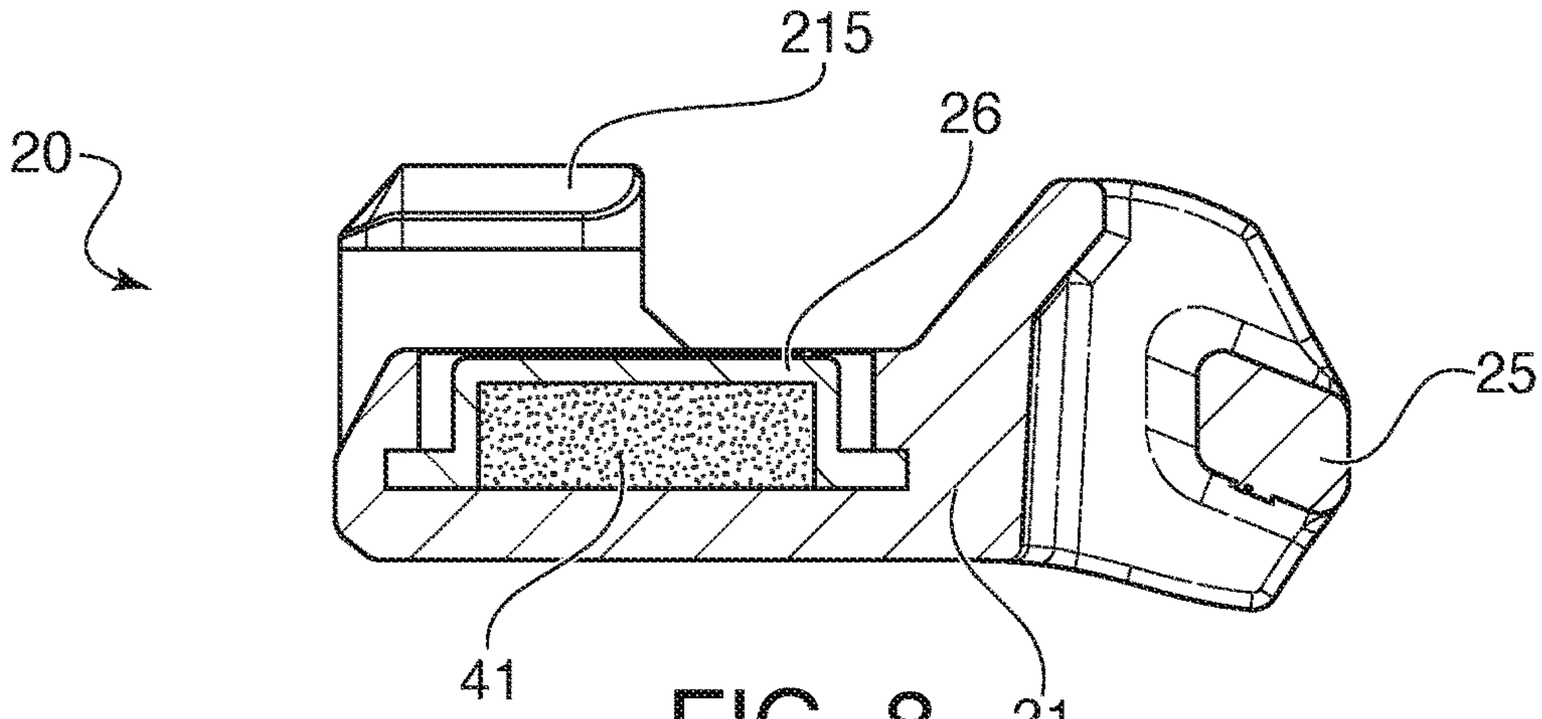


FIG. 8

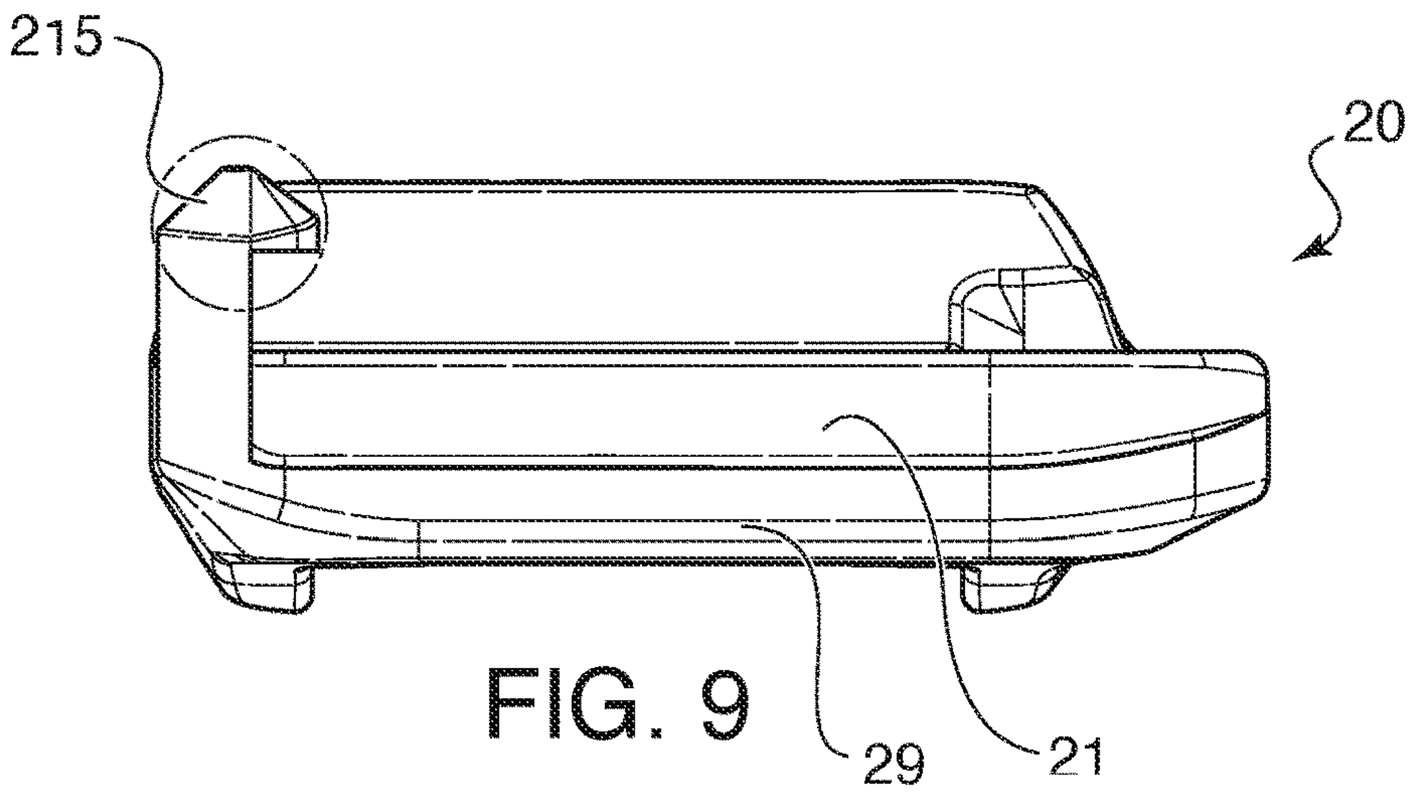


FIG. 9

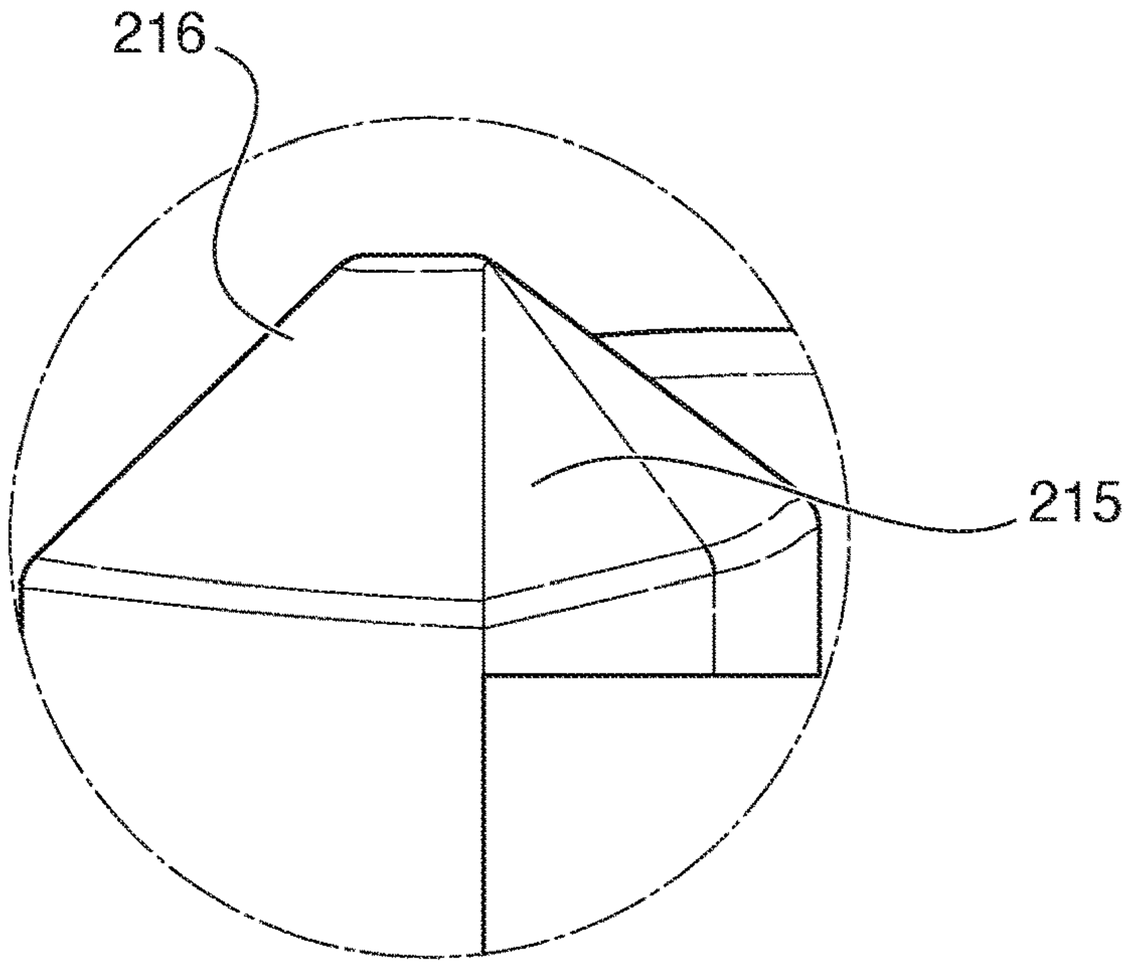


FIG. 9A

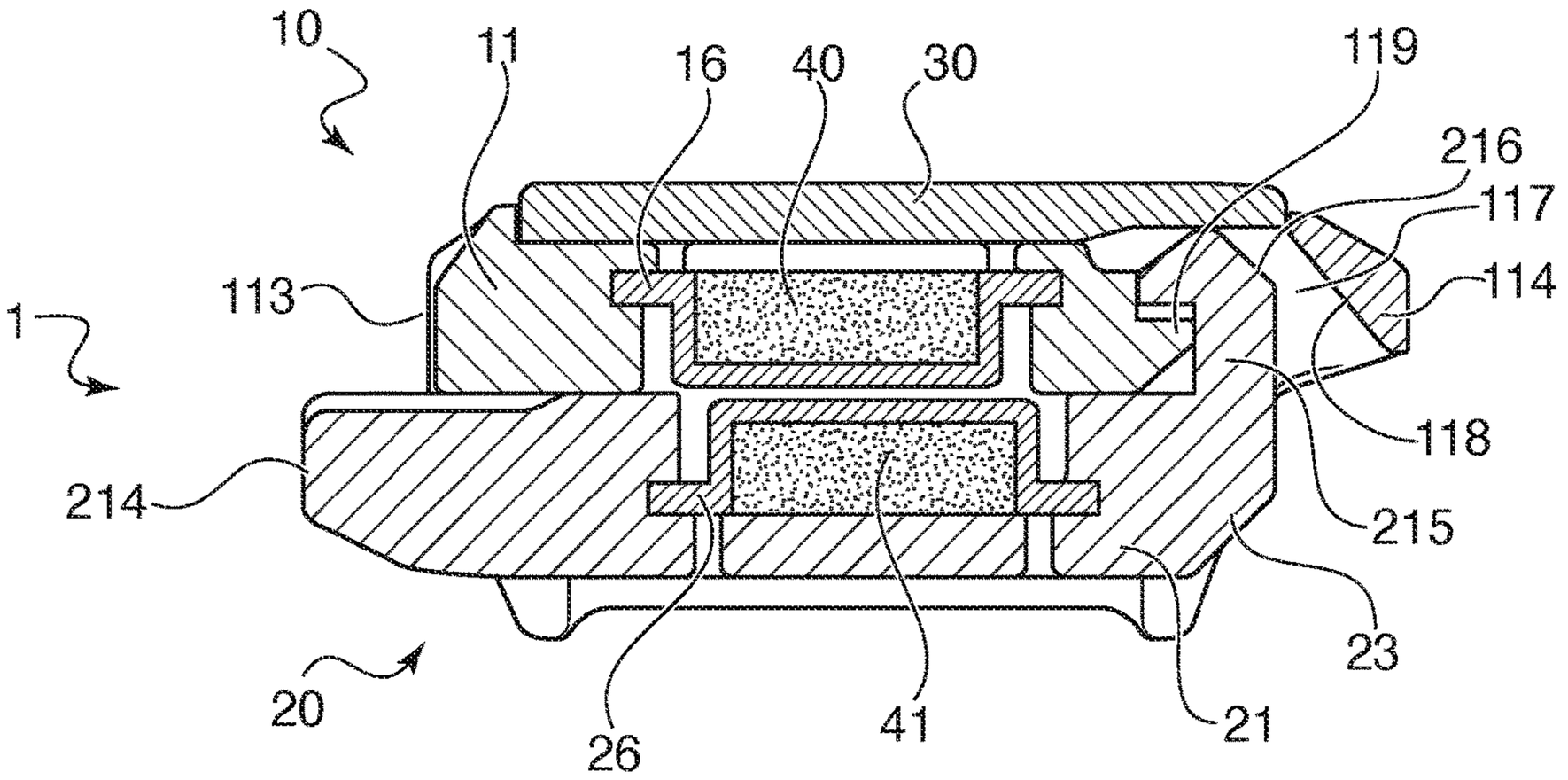
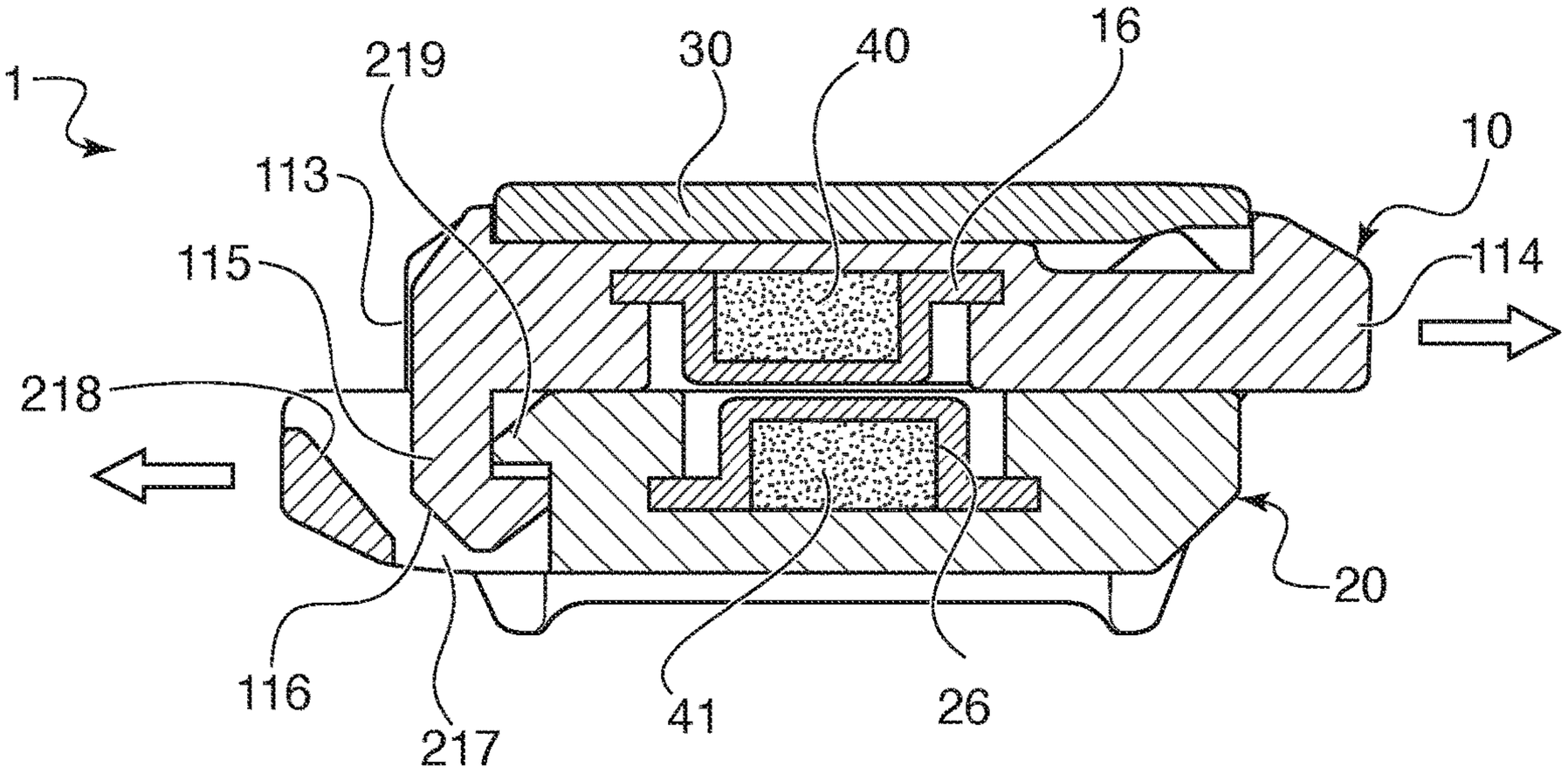

10
11
16
40
30
119
216
117
114
113
1
214
118
215
23
20
26
41
21

FIG. 10


1
219
30
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16
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113
115
114
218
20
116
217
41
26

FIG. 11

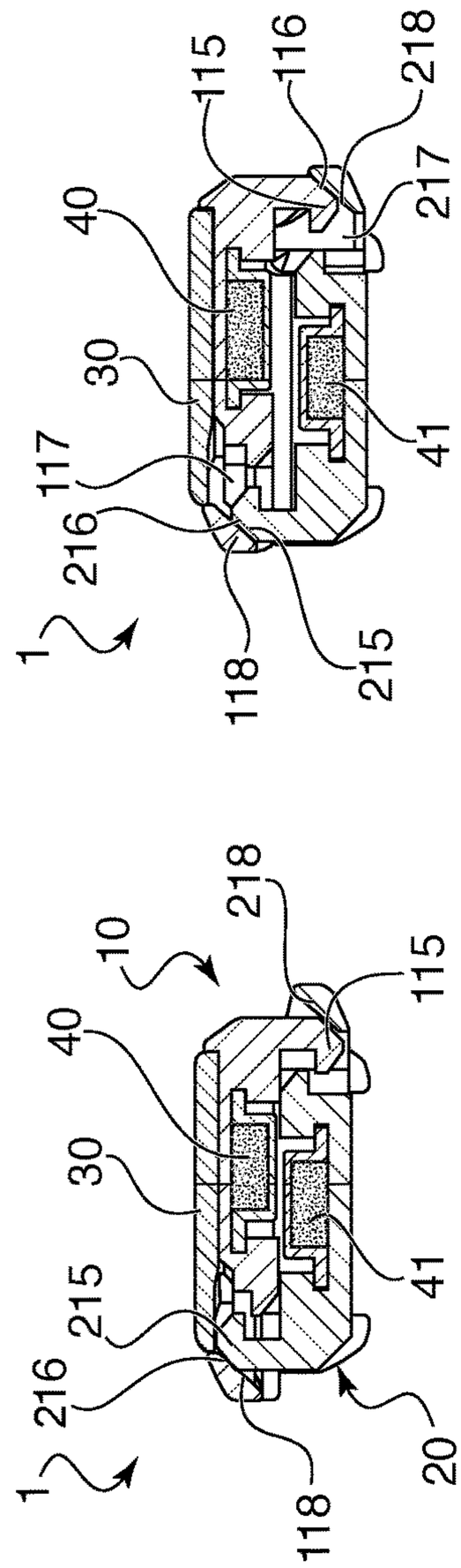

FIG. 14A

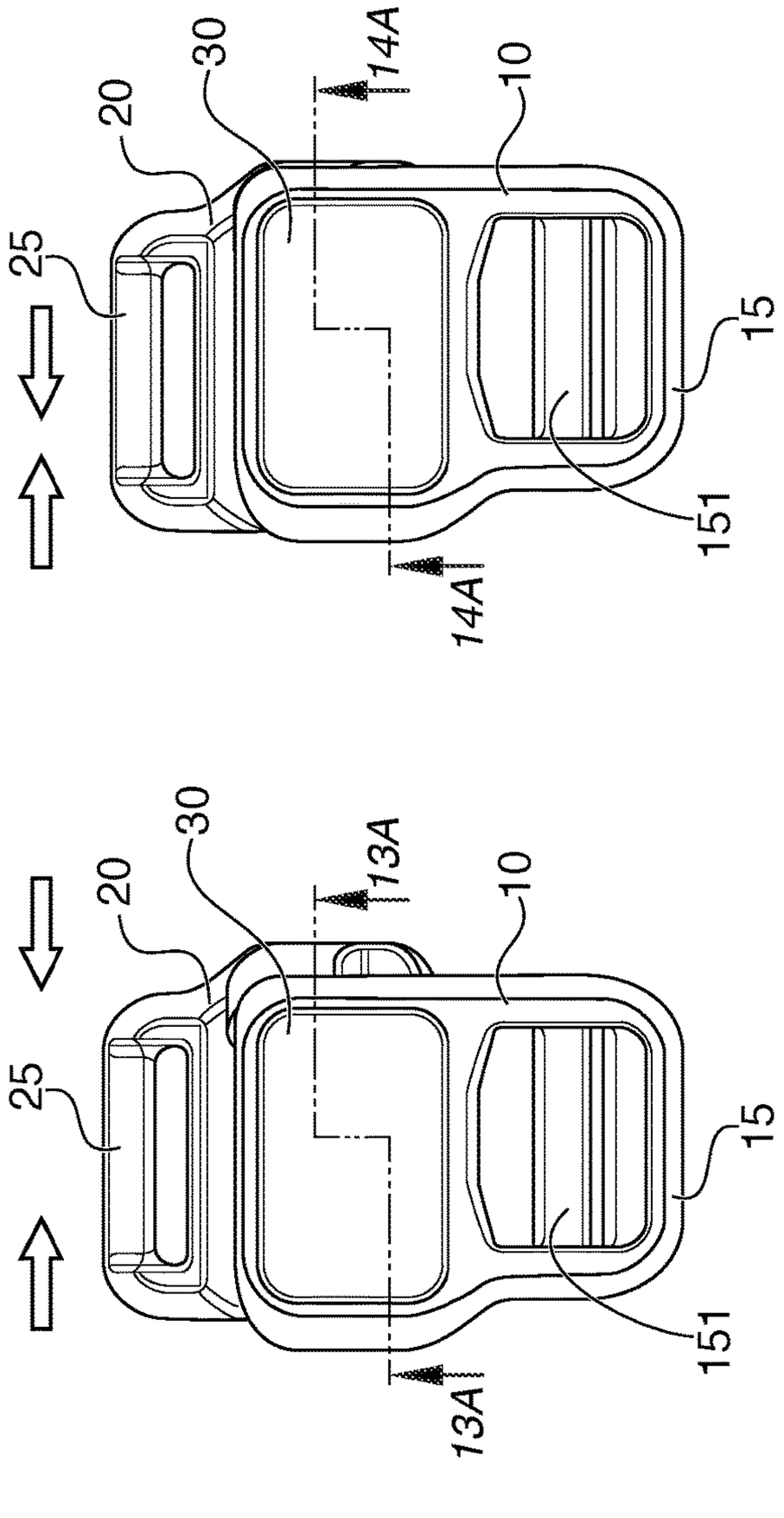

FIG. 14

FIG. 13A

FIG. 13

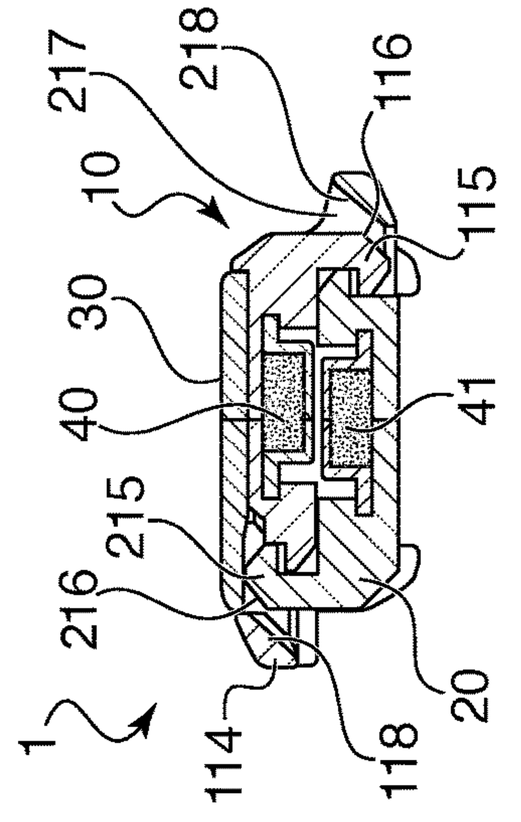

FIG. 12A

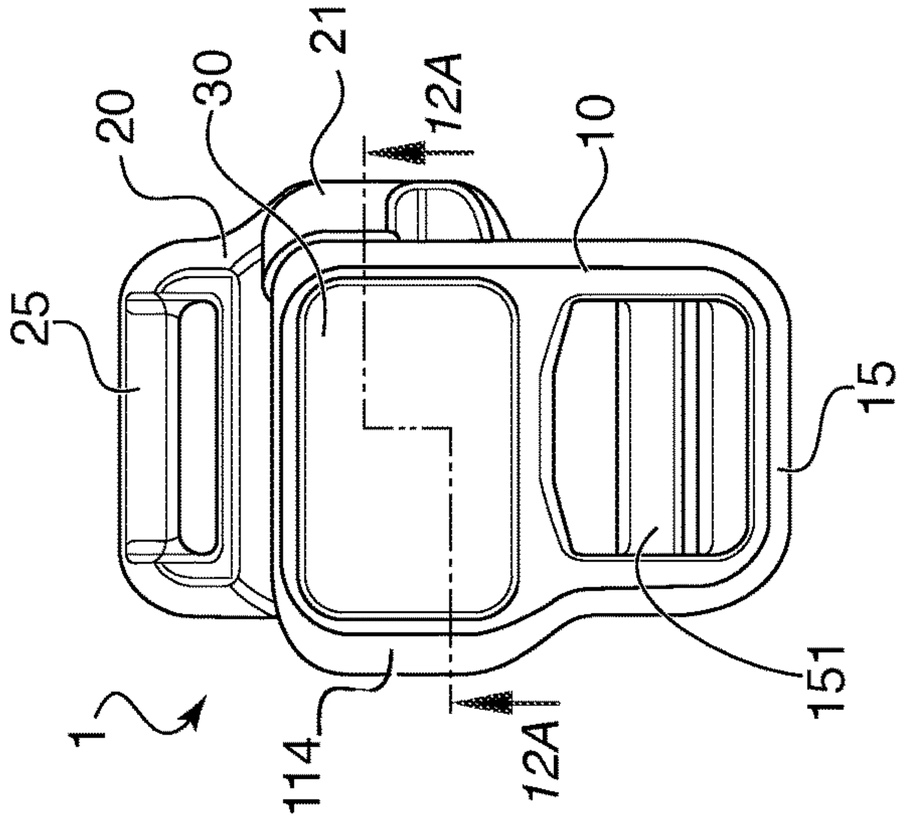

FIG. 12

MAGNETIC BUCKLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a magnetic buckle. In particular, the invention relates to a two-piece sliding buckle that is held in place by cooperating magnets on each of the pieces, and which can be easily disassembled by sliding the parts in a direction transverse to the tension direction and transverse to the attraction direction of the magnets.

2. The Prior Art

Two-piece buckles are often used to connect two straps together, such as in a seat belt. Often, the buckles are locked together via a spring-loaded latching mechanism, which can be released by raising or lowering a latch, or by pressing a button.

Magnets have been added to these buckles to enable faster and more secure attachment of the buckle parts to each other. For example, U.S. Pat. No. 11,160,330 by the inventor of the present application discloses a two-piece buckle assembly having magnets on each of the parts, to hold the parts together, along with fastening hooks on each of the buckle parts that cooperate with fastening openings on the opposition buckle part to prevent disengagement under tension. Fastening wedges are disposed opposite the fastening hooks to prevent sliding of the buckle parts. Each of the fastening hooks are located on a longitudinal end of the buckle base body, with the longitudinal direction corresponding to the tensioning direction of the buckle. While this provides a secure and effective way to prevent inadvertent disengagement of the buckle, the arrangement of the locking hooks on the longitudinal ends requires that the parts be disengaged by sliding the buckle parts longitudinally. This can be awkward or difficult in certain applications, such as in use on a helmet strap, and requires the buckle to have extra length to accommodate the hooks in the longitudinal direction.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a two-piece buckle assembly that is simple to engage and disengage in confined spaces, has a compact structure, and which does not require moving parts, such as springs or hinges, yet remains secure under tension.

This and other objects are accomplished by a buckle assembly having a first buckle portion that cooperates with a second buckle portion. Each of the buckle portions has a base body with a plurality of exterior surfaces, a plurality of interior surfaces, a first lateral side and a second lateral side. A magnet housing enclosing a magnet is disposed in the base body between the two lateral sides. A first fastening hook is disposed on the first lateral side of the first base body and projects from the interior surface of the first base body. A first fastening opening and a first guide surface are disposed on the second lateral side of the first base body. Similarly, the second buckle portion is formed by a second base body with a plurality of exterior surfaces, a plurality of interior surfaces and a first lateral side and a second lateral side. A magnet housing enclosing a magnet is disposed in the second base body between the two lateral sides. A second fastening hook is disposed on the first lateral side of the second base body and projects from the interior surface of the second base body. A second fastening opening and a second guide surface are disposed on the second lateral side of the second base body.

The first and second buckle portions are configured such that placing the interior surfaces of the first buckle portion against the interior surfaces of the second buckle portion causes the magnets to engage each other with magnetic attraction, and forces the fastening hooks of each buckle portion to enter the fastening openings of the other buckle portion, to lock the two buckle portions together and prevent disengagement under tension in opposing directions parallel to a longitudinal extent of the buckle assembly. The attractive force of the magnets serves to align the fastening hooks with the fastening openings even when the buckle portions are not placed exactly in the locking position. While the fastening hooks are in the fastening openings, forces in the longitudinal direction cannot move the hooks out of the openings, so that the buckle assembly stays locked, even under high tension in the longitudinal direction. This arrangement forms a balanced two-way load-bearing structure when buckled, and also significantly shortens the length of the buckle as compared to placing the fastening hooks on the longitudinal ends. The fixing direction is perpendicular to the bearing (tensile force) direction so that excessive forces by straps connected to the buckle cannot disengage the buckle.

However, the buckle assembly can be easily disengaged by sliding the buckle portions in opposite lateral directions, perpendicular to the longitudinal extent of the buckle assembly, so that the first fastening hook slides along the second guide surface and the second fastening hook slides along the first guide surface and forces the first and second magnets apart, breaking the magnetic attraction of the buckles. In essence, the disengagement takes place by sliding the buckle portions across one another, so that the hooks travel over the guide surface until the magnetic attraction of the magnets is broken. Preferably, each of the guide surfaces forms a slanted surface, that slants upward from the fastening opening, so that the opposing fastening hook slides along the slanted surface and travels out of the fastening opening and causes the magnets to move away from each other, in both the lateral direction, as well as a vertical direction, due to the upwardly slanted surface.

The guide surfaces are disposed adjacent the fastening openings, on the outer side of the opening between the opening and the second lateral side of each buckle portion, so that during disengagement, the fastening hook slides along and up the guide surface in the lateral direction.

The first fastening hook is preferably disposed offset in a longitudinal direction from the first fastening opening and the second fastening hook is offset in a longitudinal direction from the second fastening opening, so that in the locked position, the hooks are disposed offset from each other.

To allow for better positioning of the user's fingers during disengagement, the buckle portions are shaped so that the second lateral side of the first buckle portion extends beyond the first lateral side of the second buckle portion and the second lateral side of the second buckle portion extends beyond the first lateral side of the first buckle portion when the two buckle portions are connected together. This provides a pressing surface on both lateral sides of the buckle assembly where the user can position their fingers prior to pressing the buckle portions into disengagement. The user merely has to press their fingers together to cause the fastening hooks to travel along the guide surfaces and break the magnetic attraction.

Each of the first and second buckle portions has at least one strap-retaining bar connected to the base body at a longitudinal end. The strap retaining bar allows the buckle portions to be connected to other objects. When tension is applied on both longitudinal ends, the magnetic attraction between the magnets and the position of the fastening hooks in the fastening openings prevents the buckle assembly from disengaging. Only the pressing movement in the lateral direction allows for the hooks to clear the openings and the magnets to separate.

In one embodiment, the fastening hook of at least one of the buckle portions extends entirely though the base body of the other buckle portion when the buckle portions are fastened together, so that the fastening hook is visible from the exterior surface of the other buckle portion.

A cover can be connected to one of the buckle portions, to extend over and cover at least some of the plurality of exterior surfaces of the one buckle portion and/or cover the opening through which the hook extends.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings. It is to be understood, however, that the drawings are designed as an illustration only and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. **1** shows a top view of the buckle assembly according to the invention;

FIG. **2** shows a side view of the buckle assembly;

FIG. **3** shows a cross-sectional view along lines **3-3** of FIG. **1**;

FIG. **4** shows an exploded view of the first buckle portion;

FIG. **5** shows an interior view of the first buckle portion;

FIG. **6** shows an end view of the first buckle portion;

FIG. **6**A shows a detail of circle **6**A of FIG. **6**;

FIG. **7** shows an interior view of the second buckle portion;

FIG. **8** shows a cross-sectional view along lines **8-8** of FIG. **7**;

FIG. **9** shows an end vie of the second buckle portion;

FIG. **9**A shows a detail **9**A from FIG. **9**;

FIG. **10** shows a cross-sectional view along lines **10-10** of FIG. **2**;

FIG. **11** shows a cross-sectional view along lines **11-11** of FIG. **2**;

FIG. **12** shows a top view of the buckle assembly in a locked configuration;

FIG. **12**A shows a cross-sectional view along lines **12**A-**12**A of FIG. **12**;

FIG. **13** shows a top view of the buckle assembly partially through a disengagement action;

FIG. **13**A shows a cross-sectional view along lines **13**A-**13**A of FIG. **13**;

FIG. **14** show a top view of the buckle assembly at the completion of the disengagement action; and

FIG. **14**A shows a cross-sectional view along lines **14**A-**14**A of FIG. **14**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Referring now in detail to the drawings, FIGS. **1-3** show the buckle assembly **1** according to the invention. Buckle assembly **1** comprises a first buckle portion **10** with a base body **11** and a second buckle portion **20** with a base body **21**. On their respective outer edges, which extend beyond the overlapping portions of base bodies **11**, **21**, are strap retaining bars **15**, **25**, respectively. An additional strap retaining bar **151** is also present on buckle portion **10** to allow for adjustability of straps connected thereto. Buckle portion **20** could also be equipped with additional bars if desired.

A cover **30**, as shown separately in FIG. **4**, is connected to base body **11** of first buckle portion **10**, by protrusions **32** snapping into recess **19** of base body **11**. The other end of cover **30** is connected to base body **11** by snapping prong **31** into recess **18** to secure the cover immovably on base body **11**.

The individual buckle portions **10**, **20** are shown in detail in FIGS. **4-9**. Both buckle portions can be constructed to be identical or can be made to differ in appearance and/or structure, as long as their cooperating features are intact.

First buckle portion **10** is shown in detail in FIGS. **4-6**A. Base body **11** of first buckle portion **10** has a plurality of exterior surfaces **112** and a plurality of interior surfaces **111**. As shown in FIG. **5**, a magnet housing **16** protruding from interior surfaces **111** encases a magnet **40** therein (shown in cross-section in FIG. **3**). Magnet housing **16** is disposed in base body **11**, between first lateral side **113** and second lateral side **114**.

A first fastening hook **115** is disposed on the first lateral side **113** and extends from an interior surface **111** of base body **11**. As can be seen in in FIGS. **5-6**A, first fastening hook **115** has a sloped outer surface **116**. First fastening hook **115** is located at an end **19** of base body **11** that is opposite strap retaining bar **15**.

A first fastening opening **117** is disposed on the second lateral side **114**, slightly offset in a longitudinal direction from first fastening hook **115**. A first guide surface **118** is arranged adjacent first fastening opening **117** on the outer side of the opening on second lateral side **114**, as seen in FIG. **10**. A sloped wall **119** is disposed on the inner side of first fastening opening **117**.

Second buckle portion **20** is shown in detail in FIGS. **7-9**A. As can be seen in FIG. **7**, second buckle portion **20** has a magnet housing **26**, which encases a magnet **41** therein (See FIG. **3**). Magnet housing **26** is disposed in base body **21** and protrudes from interior surface **211**, between first lateral side **213** and second lateral side **214**.

A second fastening hook **215** is disposed on first lateral side **213** and extends from interior surface **211** of base body **21**. As can be seen in in FIG. **9**A, second fastening hook **215** has a sloped outer surface **216**. Second fastening hook **215** is located at an end **29** of base body **21** that is opposite strap retaining bar **25**.

A second fastening opening **217** is disposed on the second lateral side **214**, slightly offset in a longitudinal direction from second fastening hook **215**. A second guide surface **218** is arranged adjacent second fastening opening **217**, as seen in more detail in FIG. **11**. A sloped wall **219** is disposed on the inner side of second fastening opening **217**.

The buckle portions are locked together by moving the interior surfaces **111**, **211** of buckle portions **10**, **20**, respectively, toward each other until magnets **40**, **41** attract each other and press the buckle portions **10**, **20** together, with the locked position of the buckle assembly being shown in FIGS. **1-3** and **10-11**. At this point, first fastening hook **115** of first buckle portion **10** extends into second fastening opening **217**, and hooks under wall **219** as can be seen in the cross-section of FIG. **11**, and second fastening hook **215** extends into first fastening opening **117** and hooks under

wall **119**. The attractive force of the magnets forces the hooks toward the center of buckle assembly **10**, so that they cannot be inadvertently released during use. As can be seen in FIGS. **10** and **11**, magnets **40**, **41** are offset from each other in the fully locked position so that a constant lateral force is applied to the buckle portions in the direction shown by the arrows in FIG. **11**, to force the hooks **115**, **215** to engage with the respective walls **219**, **119** respectively of the opposite buckle portion. Walls **119**, **219** are sloped to allow the hooks **115**, **215** to slide more easily into place during assembly.

The operation of buckle assembly **1**, from moving the buckle portions **10**, **20** from the fully locked position to a releasable position is shown in FIGS. **12-14** and their respective cross-sectional views **12A-14A**. The cross-sections cut across the parts of the buckle assembly containing each of the hooks, so that rather than a straight cross-section, an offset cross section as indicated by lines **12A-12A**, **13A-13A** and **14A-14A** is shown. The straight cross-sectional views are shown in FIGS. **10** and **11**.

The fully locked position is shown in FIGS. **12** and **12A**. Here, the second lateral side **114** of first buckle portion **10** extends outward and overlaps the first lateral side **213** of second buckle portion **20**, and the second lateral side **214** of second buckle portion **20** overlaps the first lateral side **113** of first buckle portion **10**. To disengage the buckle portion **10**, **20**, the user presses the overlapping lateral sides **114**, **214** toward each other, causing the sloped outer surfaces **116**, **216** of hooks **115**, **215** to engage sloped guide surfaces **118**, **218**, as shown in FIG. **13A**. Further pressing of the overlapping sides **114**, **214** causes the sloped surfaces **116**, **216** of hooks **115**, **215** to slide along sloped guide surfaces **118**, **218** as shown in FIGS. **14** and **14A** until magnets **40**, **41** are forced apart, and the attractive force between the two magnets **40**, **41** is broken, as seen in FIG. **14A**, thus allowing separation of first buckle portion **10** from second buckle portion **20**.

The attractive force of the magnets ensures simple and reliable engagement of the buckle portions to each other, especially in tight situations where the user may not be able to see the buckle while using it. The magnets also keep the buckle portions engaged in the locked position under tension from straps. When straps are wrapped around strap retaining bars **15**, **25**, the magnets prevent buckle portions **10**, **20** from flipping over due to magnetic attraction between their exterior surfaces **112** and **212** during engagement of the buckle portions. The hook construction combined with the magnetic attraction also prevents separation of the buckle portions from one another in the vertical direction, unless the sliding action shown in FIGS. **12-14A** is undertaken first. The location of the hooks on the lateral sides allows for a very compact buckle construction, which is especially useful for certain applications having limited space for the buckle.

The present invention provides a simple and secure way to attach two buckle parts together, without requiring a large amount of force to disengage the parts and without requiring any moving parts in the buckle. The configuration of the present invention allows for simple disengagement of the buckle portions using only two fingers, even in tight spaces and under high tension, such as in use on a helmet strap.

Accordingly, while only a few embodiments of the present invention have been shown and described, it is obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. A buckle assembly comprising:

a first buckle portion comprising a first base body with a plurality of exterior surfaces, a plurality of interior surfaces, a first lateral side and a second lateral side, a magnet housing enclosing a magnet, a first fastening hook on the first lateral side of the first base body, and a first fastening opening and a first guide surface on the second lateral side of the first base body; and

a second buckle portion comprising a second base body with a plurality of exterior surfaces, a plurality of interior surfaces and a first lateral side and a second lateral side, a magnet housing enclosing a magnet, a second fastening hook on the first lateral side of the second base body, and a second fastening opening and a second guide surface on the second lateral side of the second base body;

wherein the first guide surface is disposed adjacent the first fastening opening, between the first fastening opening and the second lateral side of the first buckle portion, and the second guide surface is disposed adjacent the second fastening opening, between the second fastening opening and the second lateral side of the second buckle portion,

wherein the first and second buckle portions are configured such that placing the interior surfaces of the first buckle portion against the interior surfaces of the second buckle portion causes the magnets to engage each other with magnetic attraction, and the fastening hooks of each buckle portion to enter the fastening openings of the other buckle portion, to lock the two buckle portions together and prevent disengagement under tension in opposing directions parallel to a longitudinal extent of the buckle assembly, and

wherein the buckle portions are configured to be disengaged by sliding the buckle portions in opposite lateral directions, perpendicular to the longitudinal extent of the buckle assembly, so that the first fastening hook slides along the second guide surface and the second fastening hook slides along the first guide surface and forces the first and second magnets apart, breaking the magnetic attraction of the buckles.

2. The buckle assembly according to claim **1**, wherein each of the guide surfaces comprises a slanted surface, so that the opposing fastening hook slides along the slanted surface during disengagement of the buckle portions from each other.

3. The buckle assembly according to claim **1**, wherein the first fastening hook is disposed offset in a longitudinal direction from the first fastening opening and the second fastening hook is offset in a longitudinal direction from the second fastening opening.

4. The buckle assembly according to claim **1**, wherein the buckle portions are shaped so that the second lateral side of the first buckle portion extends beyond the first lateral side of the second buckle portion and the second lateral side of the second buckle portion extends beyond the first lateral side of the first buckle portion when the two buckle portions are locked together.

5. The buckle assembly according to claim **1**, wherein each of the first and second buckle portions have at least one strap-retaining bar connected to the base body at an end opposite the respective fastening hooks, the at least one strap retaining bar being configured to allow the buckle portions to be connected to other objects.

6. The buckle assembly according to claim **1**, wherein the fastening hook of at least one of the buckle portions extends entirely though the base body of the other buckle portion

when the buckle portions are fastened together, so that the at least one fastening hook is visible from the exterior surface of the other buckle portion.

7. The buckle assembly according to claim **1**, further comprising a cover connected to one of the buckle portions, the cover extending over at least some of the plurality of exterior surfaces of the one buckle portion.

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